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Memorandum

Date:	April 13, 2009
To:	Dr. Angela Nugent, Designated Federal Officer (DFO) EPA Science Advisory Board Clean Air Scientific Advisory Committee (CASAC)
From:	David Heinold, CCM and Robert Paine, CCM, QEP
Subject:	**Comments on Sulfur Dioxide NAAQS: Second Draft of the Health Risk and Exposure Assessment**

AECOM Environment has reviewed EPA's *Risk and Exposure Assessment to Support the Review of the SO2 Primary National Ambient Air Quality Standards: Second Draft*, which will be the subject of the April 16 and 17, 2009 meeting of CASAC. AECOM's focus for this review has been the aspects related to existing and future SO_2 concentrations and how they are extrapolated to 5-minute averages and the current NAAQS. We also comment on source characterizations used in the modeling for the exposure assessment.

1. Recent trends of SO_2 emission reductions are not accounted for.

It is evident that the trend of SO_2 ambient concentrations has been decreasing over the long term (see http://www.epa.gov/airtrends/sulfur.html). The reports of "as-is" air quality for SO_2 do not have observations after the 1997-2007 period. However, there are several SO_2 emission reduction initiatives that will result in significant reductions in peak SO_2 monitored values in the near future. One major emissions reduction initiative is the Clean Air Interstate Rule (CAIR), which has recently been reinstated by a ruling of the Court of Appeals for the District of Columbia Circuit. The December 23, 2008 Court ruling leaves CAIR in place until EPA issues a new rule to replace CAIR in accordance with the July 11, 2008 Court decision. CAIR's implementation, as noted at EPA's web site (http://www.epa.gov/cair/basic.html), will reduce SO_2 emissions by 4.3 million tons -- 45% lower than 2003 levels, across states covered by the rule. By 2015, CAIR will reduce SO_2 emissions by 5.4 million tons, or 57%, from 2003 levels in these states. At full implementation, CAIR will reduce power plant SO_2 emissions in affected states to just 2.5 million tons, 73% below 2003 emissions levels.

In urban areas especially, EPA's Ultra Low Sulfur Diesel (ULSD) fuel program is its most ambitious strategy to reduce emissions from diesel-powered vehicles (see http://www.epa.gov/compliance/civil/caa/ultralow-sulfurdieselfuel.html). Under the ULSD regulations, a minimum of 80 percent of the diesel fuel produced for highway vehicles must be ULSD with a maximum sulfur content of 15 parts per million (ppm), while the remaining 20 percent may be low sulfur diesel fuel (LSD) with a maximum sulfur content of 500 ppm. However, beginning June 1, 2010, all highway diesel fuel must be ULSD. Sulfur-in-fuel reduction to 15 ppm will also apply to locomotive and marine distillate fuel by 2012. Since this program was not fully implemented until late 2006 and continues to progress with phase-out of higher sulfur fuels, there have been and continue to be dramatic reductions of SO_2

emissions due to diesel fuel use that are not reflected in the as-is SO_2 characterization in the 2nd draft REA report.

The Best Available Retrofit Technology (BART) rule, which is part of the Regional Haze Rule implementation, has and will lead to additional SO_2 reductions in the near future. The affected emission units are those put into operation between 1962 and 1977, before the implementation of New Source Performance Standards and the Prevention of Significant Deterioration (PSD) program. This program affects all major source groups, not just electrical generating units, and will lead to additional substantial SO_2 emission reductions beyond those of CAIR in the next few years, if not already implemented.

According to EPA (http://www.epa.gov/compliance/resources/cases/civil/caa/oil/index.html), its national Petroleum Refinery Priority has addressed air emissions from petroleum refineries. Since March 2000, the Agency has entered into 24 settlements with U.S. companies that refine nearly 88 percent of the Nation's petroleum refining capacity. These settlements cover 99 refineries in 29 states and on full implementation will result in annual emissions reductions on more than 87,000 tons of nitrogen oxides and more than 250,000 tons of sulfur dioxide. EPA's settlements have recently resulted in or will soon require significant reductions of sulfur dioxide emissions.

In summary, while the news is very good on the recent and ongoing massive SO_2 emission reductions, the REA's characterization of "as-is" air quality is obsolete. Because of recent regulatory mandates regarding reductions in fuel sulfur content and permitted emissions from major sources, the ambient concentrations of sulfur dioxide from historical measurements represented in the second draft REA are likely to overestimate present day and near term concentrations by a potentially wide margin. As a result, it is likely that the degree to which present day and near future short-term SO_2 air quality could adversely affect exercising asthmatics is much lower than is characterized in the second draft REA.

2. Emissions used for the exposure analysis are out of date.

The exposure analysis described in Section 8 uses SO_2 emissions from 2002. As discussed above, the SO_2 emission levels since 2002 have already changed substantially and are continuing to change to the extent that the analysis based upon 2002 levels is obsolete. The potential impact of the SO_2 emission reductions that have not been accounted for should be addressed in the final REA.

3. The extrapolation of current air quality to current NAAQS levels is flawed.

While it is evident that the current air quality is, and will continue to be, generally well below the current SO_2 NAAQS, EPA's analysis nonetheless attempted to adjust the monitoring data as if the NAAQS were "just attained". EPA computed an adjustment factor based upon the limiting design value, and then adjusted all 1-hour average measured values by this factor. This adjustment procedure presumes that a scenario could occur where all sources of emissions uniformly increase both spatially and temporally. As noted below, this assumption is unrealistic, and it severely limits the applicability of the assessment.

A complication with the assessment is that the limiting design value can be based on either the annual average concentration or, more likely, on the second-highest daily 24-hour concentration. Current and past violations of the primary SO_2 NAAQS have generally been for the daily rather than the annual standard because only two days of unusually high emissions and unique meteorological conditions are needed to result in a monitored violation. It is much less likely that the annual SO_2 NAAQS would be and has been exceeded due to these contributory factors. Our experience with modeling assessments indicates that the 24-hour SO_2 NAAQS is consistently more controlling than the annual SO_2 NAAQS.

For the case of just attaining the 24-hour SO_2 NAAQS, it is likely that a single source or a group of sources under specific meteorological conditions that could occur for as few as just two days out of a year can lead to this scenario. Considering the increased levels of SO_2 emission controls, it is unrealistic and unreasonable to assume that all 1-hour concentrations throughout the entire year would need to increase proportionately if the more controlling 24-hour NAAQS were just attained.

Due to increasing levels of SO_2 emissions control as described above, it is counterintuitive to even consider a scenario of being barely in attainment of the current NAAQS. In such a case, however, it is likely that annual average levels of SO_2 will not increase. Instead, it is much more plausible for this scenario that occasional control equipment malfunctions and upset conditions combined with adverse meteorological conditions for just two events per year could result in a current daily SO_2 NAAQS that is barely attained. As a consequence, the procedures used by EPA to scale up all hourly concentrations to just meet the current NAAQS for considering a 1-hour SO_2 standard, assuming that it is the 24-hour SO_2 NAAQS that is more controlling, are misleading and flawed.

4. The emissions profile adjustment for the modeling assessment is erroneous.

Regarding the assessment modeling described in Section 8, EPA discusses their approach for the temporal and spatial patterns in SO_2 source emissions. EPA indicates that these patterns are influenced by the type of source(s) present, their operating conditions, and that the emission pattern is reflected in the ambient SO_2 concentration distribution measured at the monitor. However, a very important influence on the ambient concentrations, that due to dispersion effects, is not considered. For example, convective mixing during the day could cause elevated plumes to disperse more effectively to the ground than during the night, causing higher SO_2 concentrations during the day vs. the night with no diurnal change in SO_2 emissions. This has been observed in monitoring studies, such as that reported by Jacobson and McManus[1]. However, EPA chose to adjust the emissions from a source category for which there is no diurnal information, assuming that this is best way to improve the performance of the model. The resulting emission pattern shown in Figures 8-4 and 8-5 of EPA's second draft REA report are not and perhaps cannot be explained in terms of realistic emission patterns. We are not aware of any rational explanation for this diurnal pattern, which requires more than a factor of 10 change in SO_2 emissions from night to midday. Therefore, we believe that the correction to the model done through the emissions diurnal profile is invalid, and should have also considered the dispersion characterization rather than just the emissions characterization. Accordingly, the reported results of the modeling based upon specific source contributions are not reliable.

5. A probabilistic short-term NAAQS requires a probabilistic modeling approach.

Implementation of a 1-hour standard will require that modeling procedures be refined to realistically address the frequency of peak short-term impacts. This is less of a concern for standards with longer averaging times and standards that reflect the single worst-case event. The joint frequency of worst-case cumulative emissions and adverse dispersion conditions becomes more important for probabilistic ambient standards.

If modeling is conducted with the use of annual average emission for multiple sources on a continuous basis for all hours of the year, the results may underestimate 1-hour peak concentrations if combinations of higher than average emissions for multiple sources were to occur simultaneously. On

[1] Jacobson, Jay S. and John M. McManus, 1985. Pattern of Atmospheric Sulphur Dioxide Occurrence: An Important Criterion in Vegetation Effects Assessment. Atm. Env., 19: 501-506.

the other hand, use of peak emissions for all sources on a continuous basis will lead to overestimates of the frequency of peak total impacts. Therefore, modeling procedures used in the exposure assessment for a 1-hour probabilistic NAAQS must consider the use of a frequency distribution of emissions for the sources being considered in a Monte-Carlo type of approach in order to properly characterize the probabilistic nature of the intended result. This procedure should also be adopted for air quality modeling used to demonstrate compliance with a NAAQS, such as a 99% or 98% 1-hour standard. The use of peak 1-hour emissions for all sources on a continuous basis is not a valid procedure to evaluate compliance with a probabilistic 1-hour standard.